AMENDMENTS TO THE DRAWINGS

Replace the only figure, labeled Fig. (with no number) with the one labeled Fig. 1 and “Replacement Sheet” in the top margin.

A new Fig. 1A. labeled "New Sheet" in the top margin is attached to be added to the application.

Changes to Fig. 1 and new Fig. 1A are explained in the remarks section.

REMARKS

I. CHANGES TO THE DRAWINGS

The originally submitted application included only one figure, labeled Fig. (no number). This figure has been replaced by a new Fig. 1. Also, a Fig. 1A has been added. These two figures conform the figures of the specification to the written text , as is permissible.

The examiner objected to the drawings under CFR 1.83(a) for not showing every feature of the invention specified in the claims. The "mixing of the hot air with cold ambient air" recited in claim 9 is now shown in the form of a mixing zone (26) and a source labeled "ambient air." The "control means" recited in claim 9 is now shown as a control device (28). The examiner had objected to the drawing as being deficient for not showing these two items that were in the original claims as filed. Adding these features to the figures merely conforms the figures to the written text, as is permissible, and thereby does not add new matter.

Additionally, a representation of an aircraft cabin is added to the figures in phantom lines. For the original disclosure of the cabin see specification as originally filed page 4 line 29 and 30 where it states "for heating an aircraft cabin (not shown)" as well as other locations in the specification.

Fig. 1A is the same as figure 1, except that it has arrows showing flow in the event of a failure of the air conditioning unit (14). For the original disclosure of the flow see specification as originally filed, see page 5 lines 22 through page 6 line 11. Fig. 1A enhances the comprehension of the words already in the disclosure.

In addition, Fig. 1 has been redrawn to better make the changes described above.

The replacement specification being submitted herewith contains brief descriptions of both Fig. 1 and Fig. 1A.

II. CHANGES TO THE SPECIFICATION

The replacement specification contains section headings, as requested by the examiner.

The replacement specification removes references to claims 1 and 9 at page 1 line 6-7, and to claim 1 at page 2 line 11, as requested by the examiner.

The replacement specification corrects a typographical error, as pointed out by the examiner, by inserting minus signs in front of temperatures at page 1 lines 36 – 37.

The replacement specification corrects a spelling error, as pointed out by the examiner, of the word "maneuvered" at page 5 line 33.

The replacement specification corrects a spelling error, of the word "pressurization" at page 1 line 29.

At various locations the specification is changed to reflect that one figure is now two figures.

At various locations the specification is changed to reflect the mixing zone 26 and control device 28 added to the figures to correct a drawing deficiency.

"(not shown)" is deleted at page 4 line 30 of the original disclosure to reflect the drawing of the aircraft cabin in phantom lines.

These changes do not add any new matter to the specification.

III. STATUS OF THE CLAIMS:

Claims 2-11 are pending.

Claims 3 and 5-9 stand objected to, for the informalities as stated in the office action.

Claims 2-8 and 11 stand rejected under 35 U.S.C. 103(a), as being unpatentable over Williams et al. US 6,189,324 ("Williams '324") in view of Hayes et al. US 4,149,389 ("Hayes '389").

Claims 9-10 stand rejected under 35 U.S.C. 103(a), as being unpatentable over Williams '324 in view of Stubbendorff US 6,012,515 ("Stubbendorff '515").

IV. CHANGES TO THE CLAIMS RESPONDING TO OBJECTIONS.

Claim 3 has been amended in response to the examiner's objection, to insert the word "in".

Claims 5-8 are objected to for using the word "each," when the claim 11 they depended from only contained "one". Amended claims 5-8 correct this discrepancy.

Claim 9 is objected to for two informalities. Claim 9 is amended and is written in a manner consistent with the interpretation stated by the examiner.

V. THE RESPONSE TO THE REJECTIONS

Independent device claim 11 is cancelled. New claim 12 is submitted as the sole independent device claim. Claims formerly dependent from claim 11 have been amended to depend from claim 12.

Independent process claim 9 is amended. Claim 10, dependent from claim 9, has been amended to reflect the changes.

New claims 13 and 14 are added as additional independent method claims.

Applicant respectfully traverses the rejections, and requests reconsideration of the claims. The present claims patentably define over the cited prior art, for the reasons explained below.

A. Applicants' Claimed Invention:

Prior to addressing the specifics of the office action, it helps to understand that applicants' claimed invention accomplishes something that the system of Williams '324 cannot do. The following paragraph repeated from page 7 of the Office Action does not seem to appreciate this.

> "Moreover, the functionality of the device disclosed in Williams et al. is identical to that of the present invention, namely controlling the temperature in the aircraft cabin (12) in case of a failure of the air conditioning unit (60). See Williams et al., column 3, lines 63-67 and column 4, lines 1-10. Both the device from Williams et al., as well as that of the present invention, achieve that by shutting down the flow from the first hot air supply line to the air conditioning unit and by directly providing hot air from the first hot air supply line via the third and second hot air supply lines to the cabin (12). Refer to Williams et al.,"

In Williams '324, column 3 lines 65-67 state: "**catastrophic** failure of the environmental control unit 10". This is followed in column 4 lines 1-3 by, "**is actuated to provide compressor bleed air directly to the aircraft cabin 12** via the full bleed air line 56, to maintain the **pressurization** thereof" (emphasis added three places). This bleed air, going directly to the cabin (see figure 1, downstream of item 136 and upstream of the cabin), would be hot bleed air, but serving to maintain pressurization when the environmental control unit has suffered a catastrophic failure. It is unclear whether by "catastrophic failure" it is meant an unclamped or broken duct that allows the compressor bleed air to leak overboard, and therefore be unavailable to pressurize the cabin, or, if it is meant only that the system has no ability to cool the air.

In either case, the system of Williams is clearly not "control [[ling]] the temperature in the aircraft cabin." Rather, it is responding to a catastrophic situation. The system of Williams '324 would not "send air of the required temperature to the cabin" as recited in the claims. It would send only hot air to maintain pressurization so as to avoid further catastrophe. Applicants' claimed invention mixes the compressor bleed air with cold ambient air from outside the aircraft, and only that mixture is supplied to the cabin, so it is at the required temperature.

B. The Cited Prior Art

Williams '324 discloses an environmental control unit 10 for an aircraft having a cabin 12 capable of pressurisation and a turbine engine 14 (see column 3, lines 20 to 25). The unit 10 comprises a first line for supplying hot bleed air from the turbine 14 to an air cycle cooling circuit 60 (see Figure 1). An electrically operated selector valve 50

is disposed within the first line upstream of the air cycle cooling circuit 60 and comprises a first outlet 54 as well as a second outlet 58, wherein the second outlet 58 is in fluid communication with the air cycle cooling circuit 60 (see column 3, lines 58 to 63 and Figure 1). A second line branches off the first line between the selector valve 50 and the air cycle cooling circuit 60 and connects the first line to a mixer 120 for mixing cool air exiting the air cycle cooling circuit 60 with uncooled air passed through the second line (see column 6, lines 58 to 66 and Figure 1). The first outlet 54 of the selector valve 50 is connected to a full bleed air line 56, i.e. a third line, wherein the full bleed air line 56 opens into a fourth line connecting the mixer 120 to the cabin 12 of the aircraft (see Figure 1). A mechanical check valve 136 is arranged in the fourth line to prevent fluid flow from the cabin 12 or the full bleed line 56 into the mixer 120 (see column 7, lines 23 to 28 and Figure 1)

Hayes '389 discloses that in a system for the transfer of heat from an ambient heat sink of a variable temperature to a conditioned space a three-way valve may be substituted by two two-way valves (see column 4, lines 12 to 16).

Stubbendorff '515 discloses a system and method for automatically controlling the temperature within the cabin of a helicopter. The system comprises a bleed air delivery sub-system 20 having first and second bleed air conduits 24, 26. The first bleed air conduit 24 supplies hot engine bleed air to an air conditioning sub-system 60 and secondary ducts 52 of a secondary duct sub-system 50. The second bleed air conduit 26 supplies hot engine bleed air to an auxiliary heating sub-system 90. The flow of hot

bleed air into the first and second bleed air conduits 24, 26 is controlled by means of valves 28 and a regulator valve assembly 100.

As becomes apparent from figure 1 of Stubbendorf '515 the system described in this prior art document can be operated in an air conditioning mode 300 or a heating mode 400. When the system is operated in the air conditioning mode 300 (Fig. 3), it may have a first cooling sub-mode 310, or a second cooling sub-mode 320 (see column 10, lines 64 to column 11, line 4 and Fig. 3).

In the first cooling sub-mode 310 hot bleed air is supplied from the first bleed air conduit 24 to the air conditioning sub-system 60 and the secondary ducts 52 of the secondary duct sub-system 50. Hence, in the secondary ducts 52 hot bleed air mixes with cool air delivered by the air conditioning sub-system 60, wherein the temperature of the mixed air is controlled by means of a system controller 12 (see column 11, lines 16 to 35). To the contrary, in the second cooling sub-mode 320 the flow of hot bleed air into the bleed air conduits 24, 26 is prevented by closing the valves 28 and an evaporator fan 66 of the air conditioning sub-system 60 produces a flow of cool air into the primary and secondary ducts 42, 52 of the primary and secondary duct sub-systems 40, 50. When the system is operated in the air conditioning mode 300, i.e. when the system is operated in either the first cooling sub-mode 310 or the second cooling sub-mode 320, the supply of ambient air via an ambient air inlet sub-system 70 is prevented (see column 10, lines 54 to 59).

Additionally, Stubbendorff '515 describes the heating mode 400 (Fig. 4) wherein compressor 62 is inactive such that evaporator coil 64 does not provide any cooling to the hot engine bleed air supplied to the air conditioning sub-system 60 via the first bleed air conduit 24. In summary, Stubbendorff '515 describes three different "normal" operational modes, namely a first cooling sub-mode 310, a second cooling sub-mode 320, and a heating mode 400 of an aircraft cabin air temperature control system.

C. The Amended Device Claims

In Added claim 12, the second hot air supply line 18 connects the first hot air supply line 12 to a mixing zone for mixing hot air supplied via the first and the second hot air supply lines 12, 18 with cool air flowing out of the air conditioning unit 14 and that a control device is provided which is adapted to adjust a mixture of hot air supplied via the first and second hot air supply lines 12, 18 and cool air flowing out of the air conditioning unit 14 so as to achieve a required cabin air temperature. For the original disclosure of these features see specification as originally filed, page 5, lines 13 to 20.

Furthermore, claim 12 includes the additional features that the third hot air supply line 20 branching off from the first hot air supply line 12 upstream from the flow control valve 16 terminates into the second hot air supply line 18 upstream from the mixing zone. The inventive device 10 further comprises an ambient air inlet that allows the feeding of cold ambient air to the hot air supplied via the third air supply line 20. Thus, in the event of a failure of the air conditioning unit 14, the control device (that is normally used to adjust the mixture of hot air supplied via the first and second hot air supply lines

12, 18 and cool air flowing out of the air conditioning unit 14 during normal operation of the air conditioning unit 14) is also adapted to adjust the mixture of hot air supplied via the third hot air supply line 20 with cold ambient air in the event of a failure of the air conditioning unit 14. Thus, the control device achieves a required cabin air temperature in both situations. For the original disclosure of these features see specification as originally filed, page 2, lines 24 to 30, page 4, lines 16 to 22 and page 6, lines 6 to 11 as well as figure as originally filed.

Claims 2 to 8 as amended correspond to original claims 2 to 8 wherein, however, the formal objections raised in the Office Action have been considered.

D. <u>The Amended Method Claims</u>

Claim 9 is amended to have a further step of isolating the air conditioning unit (14) from the hot air source. For the original disclosure of this feature see specification as originally filed page 5 line 22 through page 6 line 5.

Claim 10 is amended to be consistent with claim 9 from which it depends.

Added claim 13 states that a portion of a controlled flow of hot air from a hot air source via a first hot air supply line 12 is guided through an air conditioning unit 14, a portion of the controlled flow of hot air from the hot air source via a second hot air supply line 18 branching off from the first hot air supply line 12 between a flow control valve 16 and the air conditioning unit 14 is guided to a mixing zone for mixing hot air supplied via the first and second air supply lines 12, 18 with cool air flowing out of the air conditioning unit 14, and a mixture of hot air supplied via the first and second hot air supply lines 12, 18 and cool air flowing out of the air conditioning unit 14 is adjusted by

means of a control device so as to achieve a required cabin air temperature. For the original disclosure of these features see claims 11 and 9 as originally filed and specification as originally filed, page 5, lines 13 to 20.

Furthermore, claim 13 contains the features that, in the event of a failure of the air conditioning unit 14, the hot air from the hot air source via a third hot air supply line 20 branching off from the first hot air supply line 12 and connecting the first hot air supply line 12 to the second hot air supply line 16 bypasses the air conditioning unit 14. For the original disclosure of this feature see claim 9 as originally filed.

Finally, features have been included into new claim 13 such that, in the event of a failure of the air conditioning unit 14, the hot air from the hot air source via the third hot air supply line 20 also bypasses the flow control valve 16 disposed in the first hot air supply line 12, so that the hot air supplied via the third hot air supply line 20 is guided into the second hot air supply line 18 upstream of the mixing zone. Cold ambient air is fed to the hot air supplied via the third hot air supply line 20 and the mixture of hot air supplied via the third hot air supply line 20 and cold ambient air is adjusted by the control device so as to achieve a required cabin air temperature. For the original disclosure of these features see claims 11 and 9 as originally filed, specification as originally filed, page 4, lines 8 to 22 and the figure as originally filed.

E. The Differences Between The Cited Prior Art and the Independent Claims

Independent device claim 12 of the present invention requires that the third hot air supply line 20 terminates into the second hot air supply line 18 upstream from the mixing zone which during normal operation of the air conditioning unit 14 is used for mixing hot air supplied via the first and second air supply lines 12, 18 with cool air flowing out of the air conditioning unit 14. This device 10 is adapted to adjust the mixing of cold ambient air with hot air supplied via the third hot air supply line 20 in the event of a failure of the air conditioning unit 14. This arrangement allows the control device used during normal operation to also be used to adjust the mixture in the event of a failure of the air conditioning unit 14. Hence, a required cabin air temperature can be achieved without the necessity to provide an additional mixing zone and/or an additional control device.

Furthermore, according to Williams '324 the full bleed air line 56 terminates into a line connecting a mixer 120 for mixing hot air supplied via the second line with cool air exiting the air cycle cooling circuit 60 to the aircraft cabin 12. Williams '324 does not disclose that cold ambient air is mixed with the hot air supplied via the full bleed air line 56 and does not contain the slightest teaching that an adjustment of the temperature of the hot air supplied via the full bleed air line 56 is necessary. Williams '324 does not teach and does not contain any hint that a control device, used during normal operation of the environmental control unit 10 can be used to adjust a mixture of cold ambient air

and hot air supplied via a full bleed air line in the event of a failure of the environmental control unit 10.

The present invention allows controlling the temperature of the air supplied to the aircraft cabin even in the event of a failure of all air conditioning units, without providing additional control devices to perform this task. Williams '324 does not.

When comparing Stubbendorff '515 to independent method claims 9, 13, and 14, Stubbendorff '515 clearly fails to describe an operation of the system for heating and cooling an aircraft cabin in the event of a failure of the air conditioning unit. In particular, the feature of the inventive method, that in the event of a <u>failure</u> of an air conditioning unit hot air <u>bypasses</u> the air conditioning unit so as to avoid damaging it, is not disclosed in Stubbendorff '515. Furthermore, the features of independent method claim 13, that in the event of a failure of the air conditioning unit the hot air from the hot air source bypasses a flow control valve disposed in a first hot air supply line, and that hot air supplied via a third hot air supply line is guided into a second hot air supply line upstream of a mixing zone, are also not described in Stubbendorff '515.

In the heating mode Stubbendorff '515, ambient air is mixed with hot bleed air supplied via the first and second bleed air conduits 24, 26, and the temperature of the air mixture is controlled by means of the system controller 12. In other words, Stubbendorff '515 the system controller 12 serves to control the air temperature in the normal air conditioning mode and the normal heating mode, but not in the event of a failure of an air conditioning unit. Furthermore, Stubbendorff '515 also does not

disclose that cold ambient air is fed to hot air supplied via a third hot air supply line bypassing an air conditioning unit.

VI. THE CLAIMS ARE PATENTABLE

As shown above, Williams '324 does not disclose the elements and features of the amended claims. Thus, merely combining Williams '324 with Hayes '389 to arrive at a device that uses two 2-way valves instead of one 3-way valve would not achieve applicants' claimed device. Nor is there any teaching in Williams '324 or Hayes '389 to suggest that it is possible to continue to control the temperature of the air being delivered to an aircraft cabin to a required temperature, by using the features recited in applicants' claims.

Stubbendorff '515 is relied on for teaching to mix ambient air with heated air for the purpose of controlling the air temperature. However, one of ordinary skill in the art would not use the teaching of Stubbendorff '515 in combination with Williams '324 because one of applicants' objectives is to bypass hot bleed air around a refrigerant system that has no active refrigerant flow, to avoid damaging the refrigerant system. On the other hand, Stubbendorf '515 specifically has a system that puts hot bleed air on a refrigerant system that has no active refrigerant flow, as stated at Column 13 line 66 though column 14 line 6 repeated here to add emphasis:

> "Referring to FIGS. 2a-g and 4, the heating mode 400 will now be discussed in greater detail. In step 401, the system controller ensures that the compressor 62 is inactive, thereby terminating the flow of refrigerant into the evaporator coils 64. In step 402, the system controller 12 ensures that the bleed air shutoff valves 28 are open, such that hot bleed air is allowed to enter the first and second bleed air conduits 24, 26." (emphasis added)

As seen in Figs. 2c and 2d of Stubbendorff '515, air entering air conduit 24 is directed via baffles 54 across evaporator coils 64 on its way to mixing region 56. Therefore, one of ordinary skill in the art would not combine the teachings of Stubbendorff '515 with the ventilation system of Williams '324. Doing so would damage the air conditioning system, rendering it nonfunctional for its intended purpose.

Further, Williams '324 teaches away from applicants' invention. Williams '324 clearly shows the third tube 56 joining a tube near the cabin 12, downstream of the mechanical check valve 136, isolating the hot air from a mixer 120. Downstream of check valve 136 is the necessary junction point in Williams '324 because if tube 56 were to join upstream of check valve 136, the hot air of tube 56 would flow back to the air cooling equipment and damage it in its inoperative (no refrigerant flow) state. Or, if "catastrophic failure" means broken and leaking, then joining upstream of the check valve 136 would leak all the pressurized air, resulting in an unpressurized cabin with, one would assume, deployed oxygen masks. Thus, Williams '324 teaches away from bringing the hot air of the third tube (20) to a mixing zone (26). To do so would not isolate the air conditioning unit from the hot bleed air.

When considering the teachings of the prior art, and the teaching-away of Williams '324, it becomes clear that the present claims would not have been obvious to one of ordinary skill in the art at the time of the invention. Only impermissible hindsight would lead one of ordinary skill to make the device of the current application.

The teachings of Hayes '389 regarding the interchangeability of one 3-way valve with two 2-way valves do not overcome what Williams '324 lacks. Therefore, even if combined with Williams '324, it would not lead to a prima facie case for obviousness.

Because claims 2-8 depend from independent claim 12, Applicants submit that claims 2-8 are also patentable.

Because claim 10 depends from independent claim 9, Applicants submit that claim 10 is also patentable.

VII. MISCELLANEOUS REMARK:

Applicants notice that US Patent 6,012,515 to Stubbendorff was not listed on form PTO - 892 as a cited reference, and brings this to the attention of the examiner for appropriate action. Applicant respectfully requests that this record be corrected to reflect its status as a reference of record.

VIII. CONCLUSION

For these reasons, applicants respectfully submit that the currently pending claims are in condition for allowance, and requests that they be allowed without further delay.

Applicants are submitting the additional fees for the added claims. Two independent claims are added, bringing the total to four independent claims, requiring payment for one independent claim. Applicant is also submitting the fee for a one month extension of time. However, if any additional fees are necessary to complete this

communication, the Commissioner may consider this to be a request for such and charge any necessary fees to Deposit Account No. 23-3000.

Respectfully submitted,

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Substitute specification – showing mark ups.

DEVICE AND PROCESS FOR HEATING AN AIRCRAFT CABIN

Technical Field

[0001] The present invention relates to a device and a process for heating an aircraft cabin. ~~in accordance with the preamble of patent claim 1 and a process for heating an aircraft cabin in accordance with the preamble of patent claim 9.~~

Background of the Invention

[0002] For controlling the climate of aircraft cabins hot air is normally taken from the engines of an aircraft. This hot air, which is called bleed air, passes through an air line including a flow control valve for controlling the flow volume to an air conditioning unit wherein the hot air is cooled to the temperature required in the aircraft cabin. In aircrafts in the cabins of which different climate zones are to be set it is also known to cool down the hot air intake by means of the air conditioning unit to the lowest temperature requirement of the various climate zones and, in order to be able to provide air for climate zones with higher temperature requirements, to guide away a certain portion of the hot air upstream from the air conditioning unit and to mix it with the air cooled by the air conditioning unit in accordance with the respective temperature requirement. With such a system, known also as the "Trim Air System", the required temperature in the individual climate zones of an aircraft cabin can be adjusted individually. If the aircraft cabin to be air-conditioned is very large, such systems are provided in multiples, e.g. double, i.e. two or more air conditioning units are provided, each comprising its own hot air supply and flow control.

[0003] There is a problem with the aforementioned systems in that in the event of a failure of all available air conditioning units the flow control throttles the volume of the hot air intake to the air conditioning units to zero in order to prevent the air conditioning unit from being damaged by the hot air. In such an event ~~pressurisation~~ pressurization and temperature control of the aircraft cabin are no longer possible (it is to be noted in this context, that the term "aircraft cabin" as used herein includes the cockpit of an aircraft). In order to supply the aircraft occupants with the necessary fresh air in the event of a failure of all available air conditioning units it is known according to the state of the art to open a flap in the aircraft fuselage and to thereby allow ambient air to enter the aircraft. However at the normal flight altitudes of an aircraft and in cold regions even in a low-flying aircraft, the ambient temperature can be below -50° C or even -60° C ~~50° C, or even 60° C~~ with the result that the temperature in the aircraft cabin can fall to values below 18°C. due to the intake of cold outside air. Such low internal temperatures, however, are impermissible for either the passengers of an aircraft or its crew without additional protection.

[0004] Starting from the prior art system as described at the outset the object of the invention is to provide remedy and to propose a system that permits temperature control of the aircraft cabin even in the event of failure of all available air conditioning units.

Summary of the Disclosed Embodiments

[0005] This object is achieved according to the invention with a device for heating an aircraft

cabin, which device comprises the features defined in the patent claims~~claim 1~~. Accordingly, in addition to a first and a second hot air supply line already provided in the case of the state of the art, the device according to the invention is provided with a third hot air supply line upstream from the flow control valve, which third hot air line branches off the first hot air supply line and connects the latter to the second hot air supply line. Further, in the second hot air supply line a first close off mechanism is disposed upstream from the point at which the third hot air supply line opens into the second hot air supply line, which close off mechanism in its closed position prevents the flow of fluid through the second hot air supply line into the first hot air supply line. Finally a second close off mechanism is disposed in the third hot air supply line upstream from the position at which the third hot air supply line opens into the second hot air supply line. In the event of a failure of all available air conditioning units this design enables hot air to be directed to the aircraft cabin by bypassing the flow control valves and the air conditioning units. Since the available hot air is generally too hot to be guided immediately into the aircraft cabin, said hot air is mixed before its introduction into the aircraft cabin with cold ambient air fed in from outside the aircraft in the conventional manner in order to obtain a desired temperature. For this purpose the air temperature control means that is used in normal operation, i.e. when the air conditioning units are functioning, can be employed.

[0006] The device according to the invention is preferably embodied such that with the air conditioning unit operating normally the first close off mechanism assumes its open position and the second close off mechanism assumes its closed position. Hot air can then flow through the flow control valve disposed in the hot air supply line and subsequently partially to the air conditioning unit and partially bypassing the air conditioning unit into the aircraft cabin. This corresponds to the normal operating mode of the heating device according to the invention wherein the third hot air supply line is without function.

[0007] The device described above can be multiply provided, i.e. there can be a plurality of first hot air supply lines each leading to its respective air conditioning unit. In this case a flow control valve is disposed in each first hot air supply line and, as described, from each first hot air supply line a second and a third hot air supply line branch off wherein are disposed, as also described, a first close off mechanism in the second hot air supply line and a second close off mechanism in the third hot air supply line.

[0008] Should the air conditioning unit or all available air conditioning units fail the device according to the invention is preferably embodied such that the flow control valve (or all flow control valves) and the first close off mechanism (or all first close off mechanisms) assume/s its/their closed position and the second close off mechanism (or all second close off mechanisms) assume/s its/their open position. This prevents hot air from reaching and damaging the failed air conditioning units while still assuring a warm air supply to the aircraft cabin. In this way the aircraft cabin including the aircraft cockpit can continue to be heated and the necessary intake of fresh air can be maintained without further action.

[0009] In the case of preferred embodiments of the device according to the invention the/each first close off mechanism is a non-return valve. Non-return valves comprise a simple technical design and are reliable in operation. They further require no actuator for their operation and therefore save weight. In place of a non-return valve the first close off mechanism may however

be formed by any device known to the person skilled in the art, which device in normal operation permits a flow of fluid from the first hot air supply line into and through the second hot air supply line and in the event of a failure of the associated air conditioning unit suppresses a flow of fluid through the second hot air supply line back into the first hot air supply line.

[0010] In the case of preferred embodiments the device according to the invention the/each second close off mechanism is formed by a stop valve, which stop valve is preferably automatically actuated. However, any device may be used as a second close off mechanism, which device in normal operation suppresses a flow of fluid out of the first hot air supply line into and through the third hot air supply line and permits this flow of fluid in the event of a failure of the air conditioning unit.

[0011] Each stop valve is preferably connected to a control means, particularly to the control means of the associated air conditioning unit, in order to open the flow path through the third hot air supply line in the event of a failure of the air conditioning unit. Alternatively the/each stop valve may also be set to a position by means of a switch in the aircraft cockpit in which position the third hot air supply line is opened.

[0012] The object cited at the outset is also achieved by a process for heating an aircraft cabin wherein a portion of a controlled flow of hot air from a hot air source is guided through an air conditioning unit and a portion is guided past the air conditioning unit into the aircraft cabin, wherein according to the invention in the event of a failure of the air conditioning unit the hot air is mixed with cold ambient air and is fed to the aircraft cabin by bypassing the flow control valves and the air conditioning unit. The cold ambient air can be mixed with the hot air at any suitable point.

[0013] To be able in the event of a failure of the air conditioning unit or all available air conditioning units to nevertheless adjust the air fed to the aircraft cabin to a particular desired temperature, in a preferred embodiment of the process according to the invention the control means that is responsible for the cabin air temperature in normal operation is also employed, which control means in this case mixes the hot air and the cold ambient air from outside the aircraft in the necessary ratio to achieve the desired temperature.

Brief Description of the Drawing

[0014] An embodiment of a device according to the invention which also exemplifies the process according to the invention will in the following be explained in more detail based on the ~~single~~ two diagrammatic ~~figure~~ figures:

[0015] Fig. 1 ~~that~~ shows the basic arrangement of the hot air supply lines and the various close off mechanisms with flow indicating arrows for normal operation.

[0016] Fig. 1A shows the basic arrangement of the hot air supply lines and the various close off mechanisms with flow indicating arrows for operation with failure of the air conditioning units.

Substitute specification – showing mark ups.

Detailed Description of the Disclosed Embodiments

[0017] ~~The~~ FIG. 1 diagrammatically shows a section of a device 10 for heating an aircraft cabin ~~(not shown)~~. The illustrated device 10 concerns such a device for an aircraft whose aircraft cabin comprises a plurality of climate zones, i.e. the cabin temperature is not to be the same throughout the cab, but is to be differently adjustable depending on climate zone.

[0018] The device 10 comprises two first hot air supply lines 12 into which hot air is drawn in from one or a plurality of engines of the aircraft and/or from an auxiliary engine (auxiliary power unit). Hot air originating from the aircraft engines is frequently described as bleed air.

[0019] Each first hot air supply line 12 guides hot air to an air conditioning unit 14 that cools the intake air to the lowest temperature required for the climate zone of the aircraft cabin having the lowest temperature. In each first hot air supply line 12 is disposed a flow control valve 16 in order to be able to monitor and control the quantity of hot air flowing to the respective air conditioning unit 14.

[0020] The air required to supply the climate zone with the lowest temperature is guided from the air conditioning unit 14 directly into the aircraft cabin. For the remaining climate zones the air exiting the air conditioning unit 14 must be heated more or less intensely. For this purpose a second hot air supply line 18 branches off downstream from the flow control valve 16 but upstream from the air conditioning unit 14 from each first hot air supply line 12 via which second hot air supply line 18 hot air bypasses the air conditioning unit 14. In a mixing zone 26 this~~This~~ hot air is mixed in the required amount with the cooled air flowing out of the air conditioning unit 14 wherein a control means 28 responsible for the cabin air temperature achieves the required temperature by adjusting the ratio of the mixture of cooled air and hot air. This arrangement is also described as a "Trim Air System".

[0021] As illustrated in Fig. 1A, in ~~In~~ the case of a failure of the air conditioning unit 14 the flow control valves 16 are closed in order to prevent the hot air from destroying the air conditioning unit 14. In order also to be able to control the temperature in the aircraft cabin in such a case a third hot air supply line 20 branches off from each first hot air supply line 12 upstream from the flow control valve 16 which third hot air supply line 20 connects the first hot air supply line 12 to the second hot air supply line 18. In each third hot air supply line 20 is disposed an automatically actuated stop valve 22 which in normal operation, i.e. when the air conditioning unit 14 is functioning, assumes its closed position in order to prevent air flowing through the third hot air supply line 20.

[0022] In an emergency, i.e. in the event of failure of the air conditioning unit 14, the stop valve 22 is ~~manoeuvred~~ maneuvered to its open position by a switch located in the aircraft cockpit or actuated by a control means connected to the stop valve 22 such that hot air can bypass the flow control valve 16 and the air conditioning unit 14 and flow to the aircraft cabin via the mixing zone 26. In order to prevent the hot air that flows through the third hot air supply line 20 from flowing through the second hot air supply line 18 back into the first hot air supply line 12 and from there to the air conditioning unit 14 and thereby damaging the air conditioning unit 14, a non-return valve 24 is respectively disposed in the second hot air supply line 18 upstream from

the opening of the third hot air supply line 20.

[0023] The hot air flowing out of the third hot air supply line 20 into the second hot air supply line 18 and from there to the aircraft cabin is mixed in mixing zone 26 before entering the aircraft cabin with cold ambient air that is fed to the device 10 via a conventional flap such as is known to the person skilled in the art and is therefore not described further here. The control means 28 also used in normal operation is employed for setting a desired cabin temperature.